

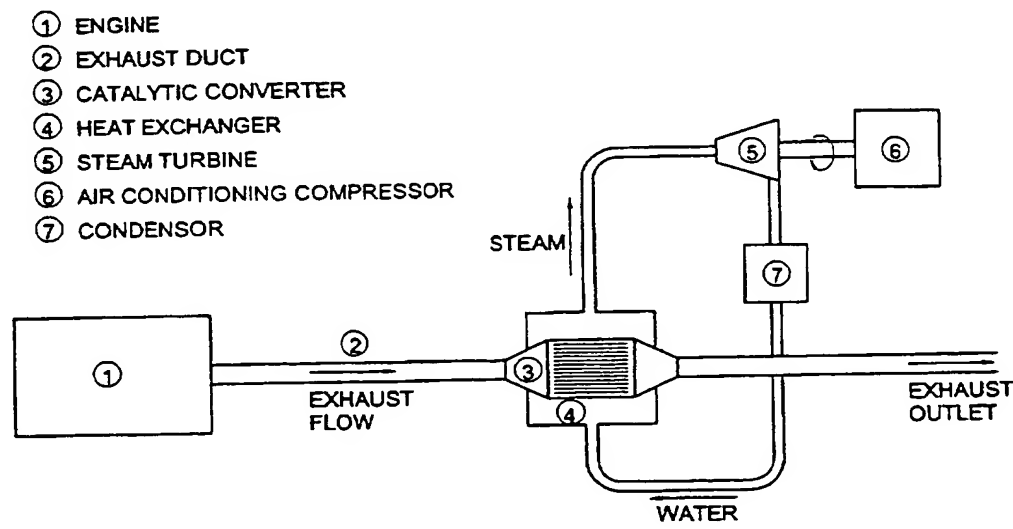
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(54) Abstract Title  
**Exhaust powered air conditioning system**

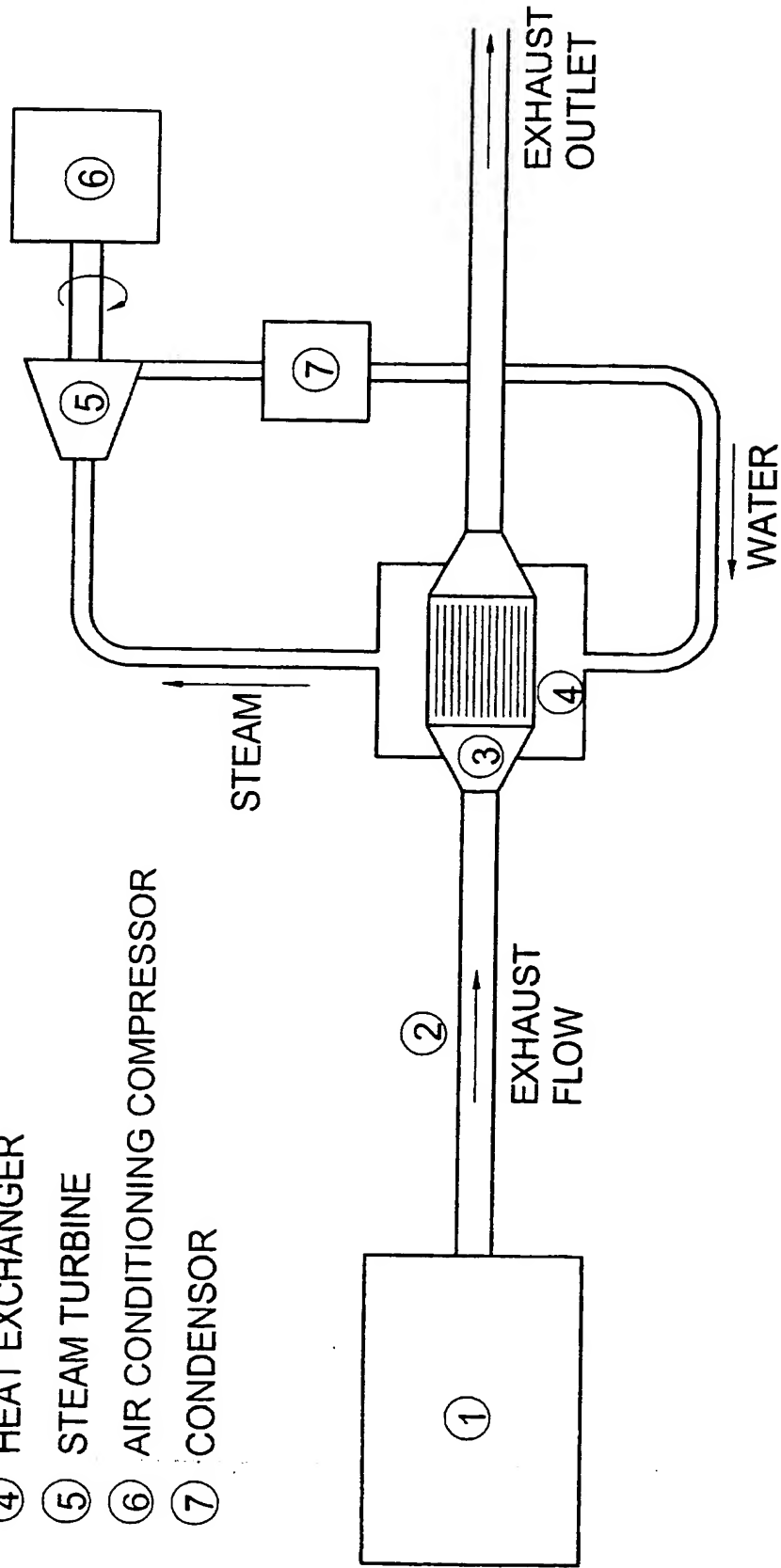
(57) A system recovers waste energy contained within the exhaust of a combustion engine to power air conditioning or refrigeration systems. Energy recovery may be in the form of pressure, temperature, velocity or chemical energy and may be used in whole or in part to power an air conditioning system. The energy may be used directly, or indirectly via transmission media, as the energy input to an air conditioning system. As shown, exhaust heat and additional reaction heat from an exhaust catalyst (3) is recovered through a heat exchanger (4) turning water into steam to drive a turbine (5) which in turn drives an air conditioning compressor (6). The steam is condensed back to water (7) and continues in the cycle. Alternatively, air could be used as the refrigerant, being compressed using recovered energy, cooled and then expanded to produce a cooled air supply.



**FIGURE 1**

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- ① ENGINE
- ② EXHAUST DUCT
- ③ CATALYTIC CONVERTER
- ④ HEAT EXCHANGER
- ⑤ STEAM TURBINE
- ⑥ AIR CONDITIONING COMPRESSOR
- ⑦ CONDENSOR



**FIGURE 1 EXHAUST POWERED AIR CONDITIONING SYSTEM**

## PATENT APPLICATION

### EXHAUST POWERED AIR CONDITIONING SYSTEM

This invention relates to the use of waste energy within the exhaust system to power (in whole or in part) an air conditioning or refrigeration system.

Many vehicles are powered by internal combustion engines, these internal combustion engines will produce an exhaust flow which contains combustion products, and which is at an elevated temperature relative to the surrounding ambient. Exhaust flows often have residual energy present in them in terms of possibly pressure, temperature, velocity and chemical energy. This energy is sometimes harnessed for secondary functions such as in turbo chargers. Furthermore in order to make the chemical composition of the exhaust acceptable within certain emission regulations the exhaust flow often passes through a catalytic convertor which promotes chemical reactions to convert the upstream exhaust chemical composition into a more acceptable one by the time the exhaust leaves to ambient air.

One particular example of a catalytic converter reaction is the oxidation of carbon monoxide to carbon dioxide using residual oxygen present within the exhaust. This reaction is exothermic and therefore releases further heat energy from the exhaust flow which is then dumped to atmosphere. The purpose of the present invention is to make use of the extra energy such as that created as a result of such catalytic converter reactions to power further plant often associated with vehicles using internal combustion engines. The particular equipment being considered here is the air conditioning system or refrigeration system of the vehicle. The air conditioning system makes use of a refrigerant which is compressed, evaporated and expanded through a cycle in order to allow heat to be extracted from air entering the vehicle and transferred to the outside ambient air. Such air conditioning systems usually represent a significant power consumption for the power plant.

Under the present invention the exothermic heat released as a result of catalytic converter reactions is harnessed and then used to drive the air conditioning system, in particular the compressor of the fluid in question. One embodiment of the system is described by way of an example shown in Figure 1, wherein exhaust from an engine (1) flows along an exhaust duct (2) and passes through a catalytic converter (3), where exothermic reactions result in a rise in temperature of the exhaust. Water is passed over the outside of the catalytic converter, extracting heat from the exhaust through a heat exchanger (4). The water is raised to steam and then drives a small steam turbine (5), which in turn drives the compressor of the air conditioning system (6). After the turbine the steam is passed through a condenser (7) and is cooled back to ambient before passing back to the heat exchanger to be heated again. Variations on this design are possible, for example, the exothermic reaction and the temperature difference created by the exhaust can be used to drive a refrigeration cycle in its own right. Furthermore, the steam generator system could be used to drive an air compressor and the air could be compressed then cooled by ambient air and then expanded into the vehicle. Alternatively the air or the steam or some of the exhaust flow could be passed through a cyclone system to allow the generation of cold temperature air to pass into the vehicle.

## CLAIMS

### EXHAUST POWERED AIR CONDITIONING SYSTEM

- 1 A system or device using waste energy contained within the exhaust system of a combustion engine to power an air conditioning or refrigeration system in whole or in part.
- 2 A system or device as claimed in Claim 1 wherein the exhaust energy recovered is in one or more of the following forms: pressure, temperature, velocity or chemical energy.
- 3 A system or device as claimed in any preceding claim, wherein the reaction heat of an exhaust catalytic converter is in whole or in part the energy used to power an air conditioning or refrigeration system.
- 4 A system or device as claimed in any preceding claim, which is used to power the air conditioning or refrigeration system of a vehicle.
- 5 A system or device as claimed in any preceding claim, which uses the waste energy from combustion engine exhaust to reduce in whole or in part the load placed on the engine by the air conditioning or refrigeration system.
- 6 A system or device as claimed in any preceding claim, wherein the recovered waste energy is used directly as the energy input to an air conditioning or refrigeration system.
- 7 A system or device as claimed in any preceding claim, wherein the recovered waste energy is used indirectly as the energy input to an air conditioning or refrigeration system using one or more transport media to convey the energy.
- 8 A system or device as claimed in any preceding claim, wherein water is used as the medium for recovery of the waste energy from the exhaust system or catalyst.
- 9 A system or device as claimed in any preceding claim, wherein water is used in a closed cycle as the medium with which to recover waste exhaust energy and directly or indirectly power an air conditioning or refrigeration system.
- 10 A system or device as claimed in any preceding claim, wherein steam is raised using the waste exhaust energy for use in powering an air conditioning or refrigeration system.
- 11 A system or device as claimed in any preceding claim, wherein steam generated by exhaust energy recovery is used to drive a steam turbine which in turn drives an air conditioning compressor.

12 A system or device as claimed in any preceding claim, wherein steam generated by exhaust energy recovery is used to drive an air compressor, the compressed air from which is then used either directly or indirectly to power an air conditioning or refrigeration system.

13 A system or device as claimed in any preceding claim, wherein steam generated by exhaust energy recovery is used to drive an air compressor the compressed air from which is cooled by ambient air and then expanded into a vehicle to produce cooled air.

14 A system or device as claimed in any preceding claim, wherein steam or compressed air generated by exhaust energy recovery is passed through a cyclone system to generate cooled air for transport into a vehicle.

15 A system or device substantially as described herein and one version of which is described with reference to Figure 1.



Application No: GB 9801324.6  
Claims searched: All

Examiner: M C Monk  
Date of search: 23 March 1999

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
UK Cl (Ed.Q): F4H (HG1C, HGXN, HG14); F4U (U41)  
Int Cl (Ed.6): B60H (1/32); F25B (27/02)  
Other: ONLINE DATABASE:WPI

### Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1368911	KATASHI AOI The generator (22) of an absorption refrigeration system uses the heat from the vehicle exhaust pipe (D).	1 at least
X	WO 87/07936 A1	AUTOMOTIVE PRODUCTS PLC The exhaust gases from the vehicle engine are used to heat liquid/vapour in the boiler (17) and the heat exchanger (18), the gases so-formed passing to a turbine. The turbine drives the compressor of a vehicle compression air-conditioning system.	1 at least
X	US 5537837	LIANG-CHI CHIANG The vehicle absorption refrigeration system uses the heat from the vehicle exhaust pipe (12).	1 at least
X	US 5383341	URI RAROPORT Exhaust pipe (4) heats the generator (5) of an absorption refrigeration system.	1 at least

X Document indicating lack of novelty or inventive step  
Y Document indicating lack of inventive step if combined with one or more other documents of same category.  
& Member of the same patent family

A Document indicating technological background and/or state of the art.  
P Document published on or after the declared priority date but before the filing date of this invention.  
E Patent document published on or after, but with priority date earlier than, the filing date of this application.



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Claims searched: All

Examiner: M C Monk  
Date of search: 23 March 1999

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Category	Identity of document and relevant passage		Relevant to claims
X	US 5231849	JOEL H ROSENBLATT The exhaust pipe (E) heats the generator (G) of an absorption refrigeration system.	1 at least
X	US 5082049	ROBERT R PISANO Heat is transferred from the catalytic converter of a vehicle exhaust system to heat the generator of an absorption refrigeration system.	1 at least
X	US 4384608	FORD MOTOR COMPANY The vehicle exhaust gases can be used to heat the evaporator/condenser (18) of a compression refrigeration system.	1 at least
X	US 4341088	MEI et al The exhaust gases from the vehicle are used to drive an absorption refrigeration system.	1 at least
X	DE 4142314	ING VERSORGUNGSTECHNIK WPI Abstract Accession No 93-281348/199336 An absorption refrigeration unit heat exchanger (2) is mounted on the exhaust manifold (3).	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.